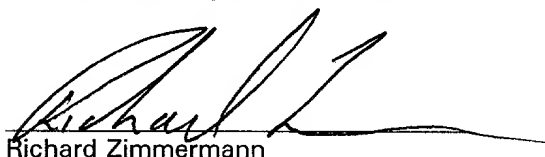


## SOLE INVENTOR

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Richard Zimmermann

## APPLICATION FOR UNITED STATES LETTERS PATENT

# S P E C I F I C A T I O N

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TO ALL WHOM IT MAY CONCERN:

Be it known that I, Paul Donato, a United States citizen, residing at 1735 York Avenue, Apt. 12B, New York, 10128, and State of New York have invented a new and useful PROMPTING OF AUDIENCE MEMBER IDENTIFICATION, of which the following is a specification.

## PROMPTING OF AUDIENCE MEMBER IDENTIFICATION

### Technical Field of the Invention

5 The present invention relates to the prompting of audience members to identify themselves when they are in a receiving area associated with a receiver whose use is being metered.

### Background of the Invention

10 It is customary in the field of audience research to employ a measurement apparatus with each program receiver within each of a plurality of statistically selected locations in order to determine tuning data. Program receivers include television receivers, radio receivers, computers, and/or other devices capable of being tuned to programs that are distributed over the air, over cable systems, by way of satellites, etc. Tuning data, for example, includes the identity of the channel or station to which the program receiver is tuned and/or the identity of the program to which the program receiver is tuned.

15  
20 It is further customary to provide a manual input device that can be used by those audience members who are actually in an audience of a receiver to indicate their identities to the measurement apparatus. This manual input

is frequently provided in the form of a Peoplemeter® which not only allows each audience member to manually enter a corresponding audience member identification but also provides a visual status indicator for showing which of the audience members have indicated that they are currently in the receiver's audience. For example, this visual status indicator may comprise a plurality of selectively illuminated light emitting diodes disposed on a box placed adjacent to a receiver and within the field of view of the audience members.

The manual input device alternatively may be a battery-powered remote control or other remote device that includes a keypad and an infra-red pulse transmitter which permit an audience member to manually enter the member's identity and to transmit that identity by way of infra-red pulses to the measurement apparatus or other data collector. The measurement apparatus or other data collector also provides a visual status indication as discussed above. An exemplary remote control of this type is disclosed by Kiewit in U.S. Patent No. 4,876,736. Still other alternative devices which collect manually entered audience member

identification data and which use the receiver to indicate the currently recorded audience status are known.

5 The tuning data from the measurement apparatus and the audience member identities from the manual input device are commonly time stamped with the times of each tuning event and/or of each change in audience composition. The time stamped tuning and audience member records are then stored in a store and forward unit within the statistically selected location for subsequent forwarding to a data collection central office, such as on a daily or other basis.

10 Because audience members forget from time to time to enter their identities, it is known to prompt the audience members to manually enter their identities. However, it is well known in audience measurement that systems relying on prompting signals sent to cooperating audience members must be concerned about the frequency of those prompting signals. If a cooperating individual perceives the prompting signals as being so frequent as to be annoying, he or she may stop cooperating. On the other hand, if the prompting is too infrequent, the cooperating individual may forget to enter data at appropriate times.

McKenna et al., in U.S. Patent No. 4,816,904,  
discloses an arrangement in which a prompting message is  
displayed on a television screen overlaid on viewer selected  
programming by mixing the prompting message with the video  
5 signal being sent to the display. However, McKenna et al.  
do not teach how to effectively regulate the prompting  
frequency.

Therefore, the present invention is directed to  
the use of tuning and/or audience response data in an  
10 adaptive prompting algorithm to select the frequency with  
which prompting occurs.

Summary of the Invention

5 In accordance with one aspect of the present invention, a method of prompting an audience member to enter an audience member identification into an audience meter comprises the following: determining a probability that the audience member is in an audience of a receiver; prompting the audience member to enter the audience member identification if the probability that the audience member is in the audience of the receiver is less than a threshold; and, suppressing prompting of the audience member if the probability that the audience member is in the audience of the receiver is greater than the threshold.

10 In accordance with another aspect of the present invention, a method of prompting an audience member to enter an audience member identification into an audience meter comprises the following: determining a variable as a function of a number of times that the audience member was in an audience of a receiver and a number of times that the receiver was turned on; prompting the audience member to enter the audience member identification if the variable is not greater than a threshold; and, suppressing prompting of

the audience member if the variable is greater than the threshold.

5 In accordance with yet another aspect of the present invention, a method of prompting an audience member to enter an audience member identification into an audience meter comprises the following: prompting the audience member to enter the audience member identification at intermittent prompting occasions; at each prompting occasion, determining a likelihood based upon past audience composition and tuning habits that the audience member is in an audience of a receiver; and, suppressing prompting of the audience member if the determination made at a corresponding prompting occasion indicates that it is likely that the audience member is in the audience of the receiver.

10  
15  
20 In accordance with still another aspect of the present invention, a method of prompting an audience member to enter an audience member identification into an audience meter comprises the following: applying a heuristic to determine whether the audience member is in an audience of a receiver; counting the audience members in the audience of the receiver to produce a count; prompting the audience member to enter the audience member identification if the

5 heuristic indicates that the audience member is not in the audience of the receiver and if the count is not equal a number of logged in audience members; and, suppressing prompting of the audience member if the heuristic indicates that the audience member is in the audience of the receiver and if the count is equal the number of logged in audience members.

10 In accordance with a further aspect of the present invention, a method of prompting an audience member to enter an audience member identification into an audience meter comprises the following: determining a probability that the audience member is in an audience of a receiver based upon both tuning history and tuning style; prompting the audience member to enter the audience member identification if the probability that the audience member is in the audience of the receiver is less than a threshold; and, suppressing prompting of the audience member if the probability that the audience member is in the audience of the receiver is greater than the threshold.

20 In accordance with a still further aspect of the present invention, a method of prompting an audience member to enter an audience member identification into an audience



meter comprises the following: determining a variable as a function of a number of times that the audience member was in an audience of a receiver and a number of times that the receiver was turned on; determining a probability that the audience member is in an audience of a receiver based upon tuning style; prompting the audience member to enter the audience member identification if the variable is not greater than a first threshold and if the probability is not greater than a second threshold; and, suppressing prompting of the audience member if the variable is greater than the threshold and if the probability is greater than a second threshold.

#### Brief Description of the Drawings

These and other features and advantages of the present invention will become more apparent from a detailed consideration of the invention when taken in conjunction with the drawings in which:

Figure 1 is a schematic diagram of an audience measurement system in accordance with an exemplary embodiment the present invention;

Figure 2 is a schematic diagram of an audience measurement apparatus of the audience measurement system shown in Figure 1;

Figure 3 is a schematic diagram of a data storage and forwarding unit of the audience measurement system shown in Figure 1;

Figures 4A and 4B form a flow chart of a prompting program that may be used in connection with the audience measurement system of Figure 1; and,

Figures 5 - 8 are tables of exemplary data useful in the explanation of the operation of the audience measurement system of Figure 1.

#### Detailed Description of the Invention

As shown in Figure 1, an audience measurement system 10 is provided at a statistically selected location 12 in which known audience members are present. The statistically selected location 12, for example, may be a household. The audience measurement system 10 includes a portable remote control device 14 which controls a receiver 16. The receiver 16, for example, may be a television receiver as shown in Figure 1, although the receiver 16

could instead be a radio, a computer, or any other receiver that is capable of being tuned to programs distributed over the air, over cable, by way of satellite, or by way of other communication methodology to the statistically selected location 12.

The portable remote control device 14 may have a user interface such as a keypad which includes buttons to allow an audience member to enter channel numbers, to change channels up and down, to increase and decrease volume, to mute the receiver 16, and to turn the receiver 16 on and off. Thus, the portable remote control device 14 can be used from a remote position 18 in order to change the channel, volume level, and so on of the receiver 16.

The keypad of the portable remote control device may also permit audience members to identify themselves when they are in the audience of the receiver 16. The names and appropriate demographic information of each of the audience members may be associated with a corresponding one of the buttons of the keypad and may be suitably stored in an appropriate memory. Accordingly, when an audience member presses a button for identification purposes, the time and date of the press, the appropriate identification, and the

appropriate demographic information may be stored with the corresponding tuning data.

5 The audience measurement system 10 is arranged to log data on audience membership (hereinafter "audience member identification data"). The audience measurement system 10 may be arranged to also log tuning data regarding the programs and/or channels to which the receiver 16 is tuned. Periodically, the logged data is transmitted over a network 20 to a data collection central office 22. The network 20 may be any mechanism for conveying the logged data to the data collection central office 22. For example, the network 20 may be a public switched telephone network, as is conventional practice in the audience measurement art.

10 The portable remote control device 14 may be used to enter member identification data into a measurement apparatus 24 which is installed adjacent to the receiver 16. The measurement apparatus 24 may also be arranged to acquire tuning data from the receiver 16 in any conventional manner in addition to the audience member identification data acquired from the portable remote control device 14. Additionally or alternatively, the audience member identification data may be entered by devices other than the

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portable remote control device 14. For example, a  
Peoplemeter® may be used to enter member identification data  
into the measurement apparatus 24 as discussed above.  
Additionally or alternatively, the audience member  
identification data may be entered by use of switches  
mounted directly on the measurement apparatus 24, or the  
audience member identification data may be entered into the  
measurement apparatus 24 by use of an electronic program  
guide (EPG). If an EPG is used, the EPG may also be used to  
enter tuning data into the measurement apparatus 24. The  
acquired tuning and audience member identification data can  
be communicated to the data collection central office 22 by  
a variety of techniques known to those skilled in the art.

The audience measurement system 10 includes a data  
storage and forwarding unit 26 which collects the tuning and  
audience member identification data from the measurement  
apparatus 24 and which stores the tuning and audience member  
identification data until a scheduled forwarding time when  
the tuning and audience member identification data are  
forwarded to the data collection central office 22. The  
data storage and forwarding unit 26 may also store and  
forward tuning and audience member identification data

collected from a measurement apparatus, similar to the measurement apparatus 24, associated with each of the other receivers (not shown) located in the statistically selected location 12. The audience measurement system 10, the measurement apparatus 24, and/or the data storage and forwarding unit 26 may be referred to herein as an audience meter.

The measurement apparatus 24 can comprise logic and a memory so that the current tuning data can be acquired and determined by the measurement apparatus 24 based upon channel selection inputs from the portable remote control device 14.

Alternatively or additionally, the measurement apparatus 24 may receive a signal replica from a signal detector 34. For example, this signal detector 34 may be in the form of a video signal source detector such as that disclosed by Chan, in issued U.S. Patent Application Serial No. 08/654,309. This video signal source detector may be positioned as taught in the Chan application to acquire a replica of a video signal from an input to a CRT of the receiver 16.

Alternatively or additionally, the signal detector 34 may be in the form of a microphone which acquires a replica of an audio output from a speaker of the receiver 16. Accordingly, the signal detector 34 is arranged to non-intrusively acquire from the receiver 16 a replica of the video and/or audio signal processed by the receiver 16.

The signal replica acquired by the signal detector 34 can then be processed by the measurement apparatus 24 according to a variety of tuning measurement methodologies. For example, (i) an ancillary video and/or audio code (such as a source identification (SID) code) identifying the tuned program or channel can be read from the signal replica, if present, (ii) video and/or audio feature signatures characteristic of the tuned program can be extracted from the signal replica and compared to reference signatures in order to identify the program or channel, and/or (iii) the signal replica can be correlated with a contemporary reference signal obtained by a reference scanning tuner controlled by the measurement apparatus 24 in order to identify the program or channel.

As a further alternative, the signal detector 34 may be arranged to detect the local oscillator frequency of

the receiver 16. This local oscillator frequency indicates the channel to which the receiver 16 is tuned, as is known in the audience measurement art.

Moreover, whether or not the signal detector 34 is employed, the measurement apparatus 24 may receive an ON/OFF input from an ON/OFF sensor 36. The ON/OFF sensor 36, for example, may be an inductive sensor which determines that the receiver 16 is on by detecting the inductive signals emanating from the receiver 16. In the case where the receiver 16 is a television receiver, the ON/OFF sensor 36 may be an inductive sensor which, as is well known, determines that the receiver 16 is on by detecting the horizontal retrace frequency of the CRT of the receiver 16. Alternatively, the ON/OFF sensor 36 may have a photodetector probe positioned in relation to the screen display of the receiver 16 so that changing light levels or the amount of light emanating from the screen display can be used to indicate when the receiver 16 is on or off. Alternatively, the ON/OFF sensor 36 can be any other type of sensor suitably arranged to determine the on/off status of the receiver 16.



5 In controlling the receiver 16, the portable  
remote control device 14 preferably operates in the manner  
of a conventional universal remote control capable of  
controlling two or more tuner appliances, such as a  
television receiver, a VCR, and/or a cable converter. Such  
a universal remote control conventionally uses several  
different code sets so that it can operate in multiple user-  
selected modes. One or more of these modes can be used to  
transmit a tuning or other command (e.g., a fast forward  
10 command sent to a VCR) to the currently active tuner (e.g.,  
the tuner of receiver 16 or of a set-top cable converter or  
of a VCR) controlling the receiver 16. In addition, one of  
the modes of the portable remote control device 14 is also  
used to transmit audience member identification data to the  
measurement apparatus 24.  
15

Optionally, the keypad of the portable remote  
control device 14 may be provided with dedicated buttons  
associated with each of the audience members. Accordingly,  
these dedicated buttons may be used by the audience members  
exclusively for member identification.  
20

The measurement apparatus 24 as shown in Figure 2  
includes a microprocessor 52 suitably connected to a

transceiver 54, the signal detector 34, a ROM 56, a RAM 58,  
the ON/OFF sensor 36, and an interface 60. The transceiver  
54, coupled to the microprocessor 52 executing a program  
stored in the ROM 56, is used to receive tuning status  
and/or audience member identification data from the portable  
remote control device 14. The tuning status data, along  
with the current audience member identification data and a  
time stamp, are temporarily saved in the RAM 58. Optionally  
or alternatively, the measurement apparatus 24 may also  
respond to the signal detector 34, as discussed above, in  
order to identify the tuned program from codes, signatures,  
or correlations, or to determine the tuned channel such as  
by detecting the local oscillator frequency of the receiver  
16. This information can be temporarily stored in the RAM  
58. The measurement apparatus 24 additionally may be  
arranged to determine the ON/OFF status of the receiver 16  
from the ON/OFF sensor 36. The ON/OFF status of the  
receiver 16 is used as discussed below in the prompting of  
audience members to enter their identifications by use of  
the portable remote control device 14 (or otherwise) in  
accordance with a prompting program described below. As  
discussed above, the measurement apparatus 24 transmits the

ON/OFF, tuning, and audience member identification data to the data storage and forwarding unit 26 by means of the interface 60.

5 Accordingly, the measurement apparatus 24 through execution by the microprocessor 52 of a program stored in the ROM 56 acquires and/or determines tuning data associated with the tuning of the receiver 16 and temporarily stores this tuning data in the RAM 58. The measurement apparatus 24 also acquires and/or determines the ON/OFF status of the receiver 16 and temporarily stores this status in the RAM 10 58. Moreover, the measurement apparatus 24 receives audience member identification data and temporarily stores this data in the RAM 58. The measurement apparatus 24 through use of the interface 60 communicates any or all of this data to the data storage and forwarding unit 26. For 15 example, the measurement apparatus 24 may communicate this data to the data storage and forwarding unit 26 immediately upon acquisition.

20 As shown in Figure 3, the data storage and forwarding unit 26 includes a microprocessor 82 suitably coupled to an interface 84, a ROM 86, a RAM 88, and an interface 90. The interface 84 and the interface 60 support

communications between the measurement apparatus 24 and the data storage and forwarding unit 26, and the interface 90 supports communication between the data storage and forwarding unit 26 and the data collection central office 22 as discussed above.

The ROM 86 stores a program 100 represented by the flow chart shown in Figures 4A and 4B in order to collect and forward tuning and audience member identification data from each measurement apparatus 24 associated with a corresponding receiver 16 in the statistically selected location 12 and to provide prompting instructions to audience members through the appropriate measurement apparatus 24 so as to prompt the audience members to identify themselves. The prompting management implemented by the program 100 relies on audience participation history of each possible audience member, by receiver and by source identification (SID) class. A SID is an ancillary code that is inserted into programs so as to identify the programs or their sources.

Other technologies, such as navigation characteristics, may provide valuable information for prompt management. Navigation characteristics indicate the manner

in which certain audience members tune the receiver 16. For example, one of the audience members may channel surf. Thus, any time that channel surfing is detected, the probability that the channel surfing audience member is in the audience may be increased. The program 100 is particularly useful where the measurement apparatus 24 cannot clearly detect channel changes.

An instance of the program 100 as shown in Figures 4A and 4B may be provided at the data storage and forwarding unit 26 for each of the receivers at the statistically selected location 12. Alternatively, the program 100 as shown in Figures 4A and 4B may be arranged to execute at the data storage and forwarding unit 26 and to accommodate all of the receivers at the statistically selected location 12. As a further alternative, an instance of the program 100 may be provided at the measurement apparatus 24 associated with each of the receivers at the statistically selected location 12.

As shown in Figure 4A, when the program 100 receives data indicating that the receiver 16 has been turned on, the program 100 at a block 102 acquires tuning data related to the receiver 16 and stores that data in the

RAM 88. At a block 104, the program 100 instructs the appropriate measurement apparatus 24 to immediately prompt the audience members in the audience of the receiver 16 to identify themselves. This prompting may be effected by on-screen displays on the receiver 16, by a visible display provided by the measurement apparatus 24 or the portable remote control device 14, by an audible message provided by the measurement apparatus 24 or the portable remote control device 14, etc.

The responsive audience member identification data is received at a block 106. In the case where the audience member identification data is provided by the portable remote control device 14 and the program 100 is executing at the data storage and forwarding unit 26, this audience member identification data is received through use of the transceiver 54 and is communicated to the data storage and forwarding unit 26 by the measurement apparatus 24.

Alternatively, the measurement apparatus 24 may be provided with input keys, switches, and the like in which case the measurement apparatus 24 receives the audience member identification data directly and communicates to the data storage and forwarding unit 26. The program 100 at a block

108 stores the audience member identification data in the  
RAM 58 or the RAM 88, as appropriate, and, at a block 110,  
also updates the SID class tables as appropriate.

5       These tables are used by the data storage and  
forwarding unit 26 to maintain a running accumulator of  
audience composition. The running accumulator is a count of  
the number of times each audience member logs onto each of  
the receivers 16 in the statistically selected location 12  
and is maintained by time period and by class of SID code.

10       The table of Figure 5 illustrates a single month's  
accumulation of data for a single household for all SID  
classes. As the table of Figure 5 indicates, days are  
broken into day parts. The table is further broken into the  
various audience members present in the statistically  
15       selected location 12, and the table further breaks down each  
audience member by receiver. As shown in Figure 5, the  
audience members are indicated by their sex and age, and the  
receivers are indicated by their location (such as bedroom,  
living room, and kitchen). However, instead of sex and age,  
20       other identifiers such as names may be used to identify the  
audience members, which may be particularly useful where  
multiple members having the same sex and roughly the same

age are present at the statistically selected location 12. Moreover, receiver location identities other than bedroom, living room, and kitchen may be assigned to the receivers used in the statistically selected location 12, which may be particularly useful where there are multiple rooms of the same room type in the statistically selected location 12.

The exemplary data provided in the table of Figure 5 indicates, for example, that the 35-49 year old female audience member used the receiver in the bedroom eighteen times to receive programs at 6:00 AM during the month covered by the table of Figure 5, that the 35-49 year old female audience member used the receiver in the bedroom nineteen times to receive programs at 6:30 AM during the month covered by the table of Figure 5, that the 35-49 year old female audience member used the receiver in the bedroom twenty-two times to receive programs at 7:00 AM during the month covered by the table of Figure 5, that the 35-49 year old female audience member used the receiver in the bedroom twenty-one times to receive programs at 7:30 AM during the month covered by the table of Figure 5, and so on. The table holds similar data for the other audience members at



the statistically selected location 12 and for other day parts.

5 The tuning occasions section of the table stores data related to how many times during each day part each receiver 16 at the statistically selected location 12 was used, regardless of the number of audience members in the audience of that receiver during that time and month. Thus, for example, the 35-49 year old female audience member used the receiver in the bedroom eighteen times to receive programs at 6:00 AM during the month covered by the table of Figure 5, and the 35-49 year old male audience member used the receiver in the bedroom one time to receive a program at 6:00 AM during the month covered by the table of Figure 5. However, there were only eighteen tuning occasions during which the receiver in the bedroom was used at 6:00 AM for the relevant month, because the 35-49 year old female audience member and the 35-49 year old male audience member used the receiver in the bedroom at 6:00 AM on the same day during the month covered by the table of Figure 5.

20 As another example, the 35-49 year old female audience member used the receiver in the living room eight times to receive programs at 6:00 PM during the month

covered by the table of Figure 5, the 35-49 year old male audience member used the receiver in the living room one time to receive a program at 6:00 PM during the month covered by the table of Figure 5, and the 12-17 year old female audience member used the receiver in the living room fourteen times to receive programs at 6:00 PM during the month covered by the table of Figure 5. However, there were only fifteen times that the receiver in the living room was on with someone in the audience during the 6:00 PM day part for the relevant month, because on several occasions there were more than one audience members in the audience of the living receiver during that day part. Thus, there were only fifteen tuning occasions during which the receiver in the living room was used at the 6:00 PM day part for the relevant month.

The counts section of the table stores data related to the sum of the data by receiver and day part for the relevant month. Thus, for example, the 35-49 year old female audience member used the receiver in the bedroom eighteen times to receive programs at 6:00 AM during the month covered by the table of Figure 5, and the 35-49 year old male audience member used the receiver in the bedroom

one time to receive a program at 6:00 AM during the month covered by the table of Figure 5. Thus, the count for the bedroom receiver is  $18 + 1 = 19$  for the 6:00 AM day part for the relevant month.

5           As another example, the 35-49 year old female audience member used the receiver in the living room eight times to receive programs at 6:00 PM during the month covered by the table of Figure 5, the 35-49 year old male audience member used the receiver in the living room one time to receive a program at 6:00 PM during the month covered by the table of Figure 5, and the 12-17 year old female audience member used the receiver in the living room fourteen times to receive programs at 6:00 PM during the month covered by the table of Figure 5. Thus, the count for the living room receiver is  $8 + 1 + 14 = 23$  for the 6:00 PM day part for the relevant month.

10           The data in the table of Figure 5 do not show any SID-specific information, but instead represent a marginal layer collapsing over all SID codes. Data collapsing is  
15           useful whenever insufficient data has been collected upon which to make predictions about the audience members in the audience of a receiver at a given day part. For example,

data collapsing is particularly useful during the first few months of initial data collection because insufficient data is likely to have been collected upon which to make predictions about the audience members in the audience of a receiver at a given day part.

The table shown in Figure 5 is only exemplary of the way in which the data may be stored. The data alternatively could be stored in an accumulator table for all sets in the household. This accumulator table is incremented each time there is a change in tuning status or audience composition and includes data for every person, time period, set, and SID class. Thus, the accumulator table may simply log each tuning event and each audience composition event in chronological order.

As a further alternative, such an accumulator table may be used to store data as they are accumulated during a month and then transferred to the type of month table shown in Figure 5 at the end of the relevant month. Other alternatives are also possible.

The tables store the basic information which is evaluated for each receiver prior to a scheduled prompt. These tables maintained by the measurement apparatus 24 or

the data storage and forwarding unit 26 preferably includes four separate tables, a table for the current month, a table for the current month - 1, a table for the current month - 2, and a total of all months up to and including the current month - 3. These tables permit a variable weighting of data by recency of behavior which may be used, for example, during data collapsing.

Thus, this recency weighting is accomplished by combining all four month tables on a weighted basis into a master table that is used for each receiver to determine whether or not to deliver the scheduled prompt to the audience at that receiver. For example, if the recency weights are 2.1, 0.3, 0.3, 0.3, then every cell in the four month tables described above would be combined, giving a weight of 2.1 to the data in the current month table and equal weights of 0.3 to the data in the other three tables.

The program 100 at a block 112 determines whether it is time to evaluate the data in the tables discussed above. For example, the block 112 may use an elapsed time timer such that the block 112 determines that it is time to perform its evaluation when the elapsed time timer accumulates an amount of time T. The time T between

5 evaluations may be set to 42 minutes or any other number of  
minutes which is deemed appropriate. Accordingly, at T  
after the receiver 16 has initially been turned on, the  
program 100 at the block 112 initiates an evaluation of the  
data stored in the tables to determine if prompting should  
be suppressed. Thus, a prompt will be given after the  
passage of T unless the evaluation indicates that prompting  
should be suppressed.

10 The evaluation is a probability-based heuristic.  
The tuning and audience composition history at the  
statistically selected location 12 is mathematically  
summarized and represented in multidimensional tables of  
counts. Each time a prompt is scheduled to be delivered,  
this information is evaluated, and, if the mathematical  
15 structure of audience composition in the household is such  
that the probability of a specific audience composition  
exceeds a certain threshold value, then the prompt is  
suppressed.

20 The heuristic is an algorithm for parsimoniously  
summarizing and retrieving knowledge stored in the tables.  
In a densely populated table, the simplest algorithm would  
search the cell most similar to the current condition,

compute straightforward probabilities for each, and, if the probability of a single tuning composition exceeded a certain threshold, the prompt would be suppressed until the next cycle.

5           The objective is to determine audience composition. Rather than treating this determination as a problem in combinatorics, this determination may be treated as a problem of individual tuning at a receiver, by SID and day part, but including terms that include co-receiving history and current response to an alternate receiver (co-location).

10           The operation of the heuristic may be illustrated with the sample frequency tables shown in Figures 6, 7, and 8. The tables shown in Figures 6 and 7 correspond to the frequency tables for two SID classifications, SID 11 and SID 15 12. These SID classes, for example, divide the programs by program type such as daytime drama, prime time drama, sports which can be further broken down into subtypes such as football, baseball, etc. Accordingly, Each SID may be 20 assigned to one of these classes. The table in Figure 8 contains a total of the data in the monthly tables (in the

example here, the total of the data in the tables of Figures 6 and 7).

5 If the block 112 determines that it is time to make an evaluation (e.g., time T has passed since the last prompt decision), a block 114 determines whether the number of persons who have logged in (i.e., identified themselves as being in the audience) equals the number of persons who have been counted in the audience. Counting of persons may be implemented by using electric eyes, proximity, or other sensing to count the audience members as they enter and leave a reception area associated with the receiver 16. A counter 90 is shown in Figure 1 for this purpose. The measurement apparatus 24 collects count information from the counter 90 and passes this count information to the data storage and forwarding unit 26 as appropriate. If the block 114 determines that the number of persons who have logged in is not equal to the number of persons who have been counted in the audience, a block 116 permits the prompt to be given to the audience members at the receiver 16 corresponding to the program 100.

20 On the other hand, if the block 114 determines that the number of persons who have logged in is equal to



the number of persons who have been counted in the audience,  
a block 118 determines a variable NUMBER as a result of  
dividing a data value COUNTS by a data value TUOCC. The  
data value COUNTS is taken from the counts row, at the  
receiver location, during the day part, and for the SID  
class corresponding to the current day part and the current  
SID of the program being received by the receiver  
corresponding to the program 100. For example, if the  
current day part is 6:30 AM, if the SID from the program  
being received by the appropriate receiver is in SID class  
11, and if the appropriate receiver is the bedroom receiver,  
the data value for COUNTS is 19.

The data value TUOCC is taken from the tuning  
occasions row, at the receiver location, during the day  
part, and for the SID class corresponding to the current day  
part and the current SID of the program being received by  
the receiver corresponding to the program 100. For example,  
if the current day part is 6:30 AM, if the SID from the  
program being received by the appropriate receiver is in SID  
class 11, and if the appropriate receiver is the bedroom  
receiver, the data value for TUOCC is 19.

Therefore, the variable NUMBER is determined as  $19/19 = 1.0$ . If either the numerator or denominator which is used to determine the variable NUMBER falls below a predetermined threshold, it may be necessary to collapse each cell in the tables from right to left (SID, and then receiver) until this threshold is reached because there are otherwise insufficient data in the SID tables on which a prediction can be based. Following such data collapsing, the variable NUMBER may be recomputed.

A block 120 determines whether the variable NUMBER exceeds a corresponding threshold. If the variable NUMBER does not exceeds the corresponding threshold, the block 116 permits the prompt to be given to the audience members at the receiver 16 corresponding to the program 100. On the other hand, if the variable NUMBER exceeds the corresponding threshold, a block 122 rounds NUMBER to the nearest integer and compares the rounded NUMBER to the current persons count. This current persons count may be derived, for example, by summing the number of audience members who have logged into the measurement apparatus 24 at the receiver 16 corresponding to the program 100. Alternatively, the current persons count may be derived by using the sensing

described above to count the audience members as they enter and leave a reception area associated with the receiver 16. If the rounded NUMBER is different than the current persons count, the block 116 permits the prompt to be given to the audience members at the receiver 16 corresponding to the program 100.

On the other hand, if the rounded NUMBER is not different than the current persons count, the variable NUMBER is consistent with history as represented by the data in the tables so that the audience members can be further evaluated by the program 100. Therefore, if the rounded NUMBER is not different than the current persons count, a block 124 sets a variable PREDICTED PERSON equal to the person having the maximum probability of being in the audience of the receiver 16 corresponding to the program 100. For example, using the tables of Figures 6-8 and as described above, the person having the maximum probability of being in the audience of the bedroom receiver at the current time (6:00 AM + T) watching a program in SID class 11 is the 35-49 year old female. Therefore, the variable PREDICTED PERSON is set to the 35-49 year old female.

Also, the block 124 computes the probability that the PREDICTED PERSON (the 35-49 year old female in the example) is in the audience by dividing the number of times the 35-49 year old female tuned into a program having the relevant SID class and during the current day part by the count for that SID class and day part. For example, the probability that the 35-49 year old female is in the audience of the bedroom receiver which is tuned to a program having the SID class 11 at and during the current time (6:00 AM + T) is 19/20 using the table of Figure 6. This probability 19/20 may be adjusted by a lead-in adjustment factor  $F_{LI}$ . This lead in factor  $F_{LI}$  is used to adjust the computed probability when the PREDICTED PERSON was in the audience of the relevant receiver during the immediately preceding day part. This lead in factor  $F_{LI}$  may be a predetermined number set to a suitable value greater than one and is multiplied by the computed probability in order to increase the computed probability.

Following the processing at the block 124, the program 100 at a block 126 determines whether the probability calculated at the block 124 is less than a predetermined threshold. If the probability calculated at

the block 124 is less than this predetermined threshold, the block 116 permits the prompt to be given to the audience members at the receiver 16 corresponding to the program 100. It is noted that there may be insufficient data in the tables at this point during the execution of the program 100, in which case the data may be collapsed as indicated above. However, if the data is so collapsed, it is likely that the probability calculated at the block 124 is less than a predetermined threshold, so that it is correspondingly likely that a prompt will be permitted.

On the other hand, if the probability calculated at the block 124 is not less than the predetermined threshold, the program 100 at a block 128 determines whether the audience member, who is in the audience of the receiver 16 corresponding to the program 100 and who has entered his or her identification into the corresponding measurement apparatus 24, is the PREDICTED PERSON. If the audience member, who is in the audience of the receiver 16 corresponding to the program 100 and who has entered his or her identification into the corresponding measurement apparatus 24, is not the PREDICTED PERSON, the block 116

permits the prompt to be given to the audience members at the receiver 16 corresponding to the program 100.

On the other hand, if the audience member, who is in the audience of the receiver 16 corresponding to the program 100 and who has entered his or her identification into the corresponding measurement apparatus 24, is the PREDICTED PERSON, then the program 100 at a block 130 suppresses prompting.

After the block 116 permits the prompt to be given to the audience members at the receiver 16 corresponding to the program 100, or after the block 130 suppresses prompting, the elapsed time timer used by the block 116 is reset, and the program 100 returns to the block 116 in order to repeat the execution of blocks 112-130 at 6:00 AM + 2T and at each increment of T thereafter.

At a particular time during the day, the data storage and forwarding unit 26 communicates its stored tuning and audience member identification data to the data collection central office 22.

Other events may also be used by the block 116 of the program 100 to trigger prompts. Such other events include, for example, a channel change when no audience

5 member is logged in, the passage of a predetermined number  
of days when a particular household member has not logged  
in, the passage of a predetermined number of days when a  
short term visitor has not logged in, no log ins when the  
receiver 16 is turned on, no log ins of particular household  
members (such as children) when the receiver 16 is tuned to  
particular programs (such as children's programming), and  
the like.

10 As described above, navigation characteristics may  
provide valuable information for prompt management.  
Navigation characteristics indicate the manner in which  
certain audience members tune the receiver 16. Thus, in the  
same way that tuning to individual programs or tuning during  
specific day parts or on specific sets may be correlated  
15 with a particular household member as described above,  
tuning styles may also be associated with individual  
household members. Accordingly, when tuning patterns are  
evaluated, the styles in which people select their programs  
may also be evaluated.

20 Tuning styles can be described by a variety of  
terms depending on which paradigm is being used to  
conceptualize receiver tuning. Tuning styles can be

considered to mean or include "navigational patterns",  
"biometric signatures," or "keystroke dynamics." These  
styles can be characterized by some very simple "statistics"  
or by more complex forms of representing knowledge.

5               "Statistics" are formally defined by  
mathematicians as a mathematical projection of a vector or  
set of data onto a single or simple set of parameters.  
Thus, statistics are used, in effect, to summarize data. A  
mean is an example of a statistic which may be used to  
10 summarize a set of data. However, in summarizing data,  
certain knowledge about the data, such as variance,  
kurtosis, skew, and, of course, the exact value of each data  
point, is lost. Therefore, the statistics used to summarize  
the data may or may not be sufficient.

15               "Sufficiency" in theoretical statistics refers to  
the ability of a "statistic" to reproduce the required  
detail of a data distribution. In some households, a simple  
statistic can "sufficiently" represent tuning style. One  
such statistic is the average number of stations or programs  
20 tuned per time period. For example, if one audience member  
views "appointment television" (i.e, an audience member  
tunes to a channel carrying a selected program and stays on



that channel throughout most or all of the selected program), the average number of stations "hit" per half hour will be very small. But if another audience member is a "surfer," the average number of "hits" per half hour will be much, much larger. While summaries of the tuning habits of these audience members may cause knowledge of variance and skew to be lost, the sheer difference between the average velocities (average rate of channel change) of these two audience members is sufficient to distinguish between these audience members. Thus, in this example, the mean rate of  $\Delta$  is sufficient to identify the individual.

However, in some households, there may be several members that have the same average rate of channel changing (velocity). In this case, the only way to distinguish these households is to consider channel velocity along with other parameters of tuning which might provide "sufficiency" in order to identify the recent presence of a household member.

For example, for every time period T (e.g.,  $\frac{1}{2}$  hr), the average number of channels tuned during that half hour may be recorded and stored in the tables of Figures 6-8 for every individual logged on to a receiver. However, velocity may not be sufficient to distinguish between people whose

5 "instantaneous rate of change", often called acceleration,  
is different. For example, two people may average twenty  
channel hits per half hour with one of the people  
methodically surfing by watching every other hit for a  
10 minute or two, while the other of the two people surfs  
through twenty channels, finds an appealing program, and  
then watches for a half hour. The average velocity is not a  
sufficient statistic to distinguish these two audience  
members. However, their acceleration can be used to  
15 distinguish between them.

There are several statistics that can represent  
"acceleration." An exemplary statistic to represent  
acceleration is given by the following description. If it  
assumed that the time period is thirty minutes, the  
15 following ratio may be used to characterize acceleration:

$$\frac{\text{\# of channels in past 30 minutes}}{\text{\# of minutes in which channel was changed in past 30 minutes}}$$

For example, if twenty channels were hit in ten separate minutes of tuning, then the acceleration is  $20/10$  or a modest 2. On the other hand, if twenty channels were hit in two minutes of surfing, then the acceleration is  $20/2$  or a moderate ten.

In some homes, even "acceleration" may not be sufficient to distinguish between audience members. For example, it may be the case that where an audience member surfs in a program or channel space is the key to distinguishing between two audience members. Therefore, in such households, a learning heuristic can be used to classify the "cluster of channels" that an audience member surfs and to match this surfing cluster to the "clusters of programs" to which an audience member tunes. Accordingly, classification and matching may be done specifically to distinguish between the channel-surfing patterns of two audience members with similar velocity and acceleration histories.

Accordingly, the probability determined at the block 124 can be adjusted up or down by velocity, acceleration, and/or program clustering. Alternatively, any

combination of these factors can be included in the program 100 as one or more decision blocks.

5 Certain parameters used by the program 100 may be downloadable from the data collection central office 22 to the measurement apparatus 24 or the data storage and forwarding unit 26 and stored in the RAM 58 or the RAM 88. For example, the parameter T may be downloaded.

10 Certain modifications of the present invention have been discussed above. Other modifications will occur to those practicing in the art of the present invention. For example, it is noted that the portable remote control device 14 may function in several different modes as described above. However, each of these modes may use a separate corresponding remote control.

15 Also, the present invention as described above relies on the use of certain infrared transceivers. However, it will be appreciated that other signaling modes, such as ultrasonic or spread-spectrum radio, could instead be employed.

20 In addition, the present invention as described above relies on the use of transceivers. Instead, a

separate receiver and transmitter could be used in place of each transceiver.

Moreover, as discussed above, instead of executing the program 100 at the data storage and forwarding unit 26, the program 100 can be executed at each measurement apparatus 24 within the statistically selected location 12. In this case, the data storage tables shown in Figures 5-8 may be modified by eliminating the receiver category. Also in this case, the storing and forwarding function performed by the data storage and forwarding unit 26 can be performed by the measurement apparatus 24 so that the data storage and forwarding unit 26 can be eliminated.

Furthermore, as described above, the portable remote control device 14 according to the first embodiment of the invention transmits tuning commands which are received by both the controlled tuner and by the measurement apparatus 24. The controlled tuner responds by effecting the tuning indicated by the tuning command, and the measurement apparatus 24 responds by recording the tuning event. Instead, in accordance with the teachings of U.S. Patent No. 4,876,736, the portable remote control device 14 may be arranged to transmit tuning commands using codes

5 recognized by the measurement apparatus 24 but not by the  
tuner of the receiver 16. Thus, the measurement apparatus  
24 records the tuning event, converts the code into a form  
recognized by the tuner of the receiver 16, and passes the  
converted tuning command on to the tuner of the receiver 16.

10 Also, a different portable remote control device  
14 could be assigned to each person in the household (with  
additional portable remote control devices provided to  
visitors). Each person would then carry his or her portable  
remote control device within the household. The  
individual's portable remote control device 14 can then be  
arranged to periodically transit an identification signal to  
the measurement apparatus 24 either based upon time  
increments or based upon a command issued by the measurement  
15 apparatus 24.

20 Moreover, the prompting permitted by the block 116  
may have multiple levels. For example, at the lowest level,  
the initial prompt could be flashed for 10 seconds. If the  
audience responds appropriately, the program 100 resumes  
normal execution. If the audience does not respond  
appropriately within a predetermined amount of time (e.g. 20  
seconds), and the prompt is flashed for 20 seconds at a

higher flash rate. If the audience responds appropriately, the program 100 resumes normal execution. If the audience still does not respond appropriately, the block 116 may be arranged to provide an audible tone or a voice command.

5 Different and/or additional levels of prompting may be provided.

10 In addition, it may be deemed desirable for audience members to manually update audience composition without prompting as changes in audience composition occur. Prompting serves mainly as a fail-safe, when sufficient time has elapsed without any unprompted change. Therefore, the elapsed time timer used by the block 116 may be reset at each entry of any audience member identification data whether prompted or not.

15 As an additional contingency, the interval T between prompts could be lengthened or shortened in order to reinforce timely entry of audience changes. This adjustment of T could be based on the data entry performance of audience members. For example, if a particular audience member typically waits until a prompt appears before reporting an earlier audience change, then the data record will show an improbably high proportion of reported audience

20

changes coinciding with the appearance of the prompt. If this pattern of performance is observed, the program 100 may shorten the interval T between prompts. Shortening the interval T between prompts will tend to reduce any possible lags between the occurrence and reporting of audience changes, as well as to provide a mild negative reinforcement for audience members who fail to report audience changes as they occur.

Alternatively or additionally, it is possible that audience members will report audience changes when they occur and that the intervals T between prompts are shorter than the interval during which no audience change actually occurs. If this pattern is observed, it may be that the prompting interval T is shorter than required for this audience member. In this instance, the program 100 may lengthen the interval T between prompts in order to provide a positive reinforcement. Indeed, different prompting intervals T could be set for various audience members, depending on their previous performance.

Furthermore, the heuristic of the present invention as described above relies upon the representation of tuning history and/or style knowledge in the form of a



series of probability tables. Such knowledge, however, can be represented in other forms. For example, as receiver tuning events occur, data relating to these events could be stored in a covariance matrix which could then be evaluated through regression, discriminant, or other parametric techniques which would develop prediction scores for each potential household member. Similarly, non-parametric techniques for representing knowledge, such as weighted digraphs, may be used to represent such knowledge.

Conceptually, the heuristic has been described above using the simplest form of knowledge representation. However, an important element of the heuristic is its capacity to manage user prompts or questions regardless of how such tuning histories (knowledge) are represented.

Also, as viewed from the standpoint of a meter, audience members have features: what programs they watch, when they watch, with whom they watch, where they watch, and how they change channels. In some households, one or two of these statistics may suffice to discriminate between audience members. In other households, at certain times of day, many of these statistics may be required. Thus, in a more advanced form of the heuristic described above,

aperiodic analysis could be conducted in each household to evaluate the structure, among household members, of each of these features. For example, in a two-person household, one person may surf while the other tunes by appointment. This household would be highly structured with respect to acceleration. In this case, the negentropy, or information content ( $h^2$ ) of acceleration, is very high. In an advanced heuristic, the values of each of these features would be weighted by their information content, that is, their ability to discriminate among audience members.

In addition, specific hardware is described in relation to Figures 1, 2, and 3. However, it should be understood that other hardware and/or software arrangements may be used to implement the present invention.

Accordingly, the description of the present invention is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the best mode of carrying out the invention. The details may be varied substantially without departing from the spirit of the invention, and the exclusive use of all modifications which are within the scope of the appended claims is reserved.